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⑮ 石材等切断用ダイヤモンドブレードの製造法

相模原市上鶴間5丁目6番5-  
303

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相模原市上鶴間5丁目6番5-  
303

⑰ 発明者 井上仁郎

1. 発明の名称

石材等切断用ダイヤモンドブレードの製造法

2. 特許請求の範囲

石材等切断用ダイヤモンド<sup>ブレード</sup>の外周辺部に接着するチップとして、各チップを奇数個のダイヤモンド層小片と、偶数個の非ダイヤモンド層小片とを以て構成し、各チップの前、後端にはダイヤモンド層小片を配置し、中間部には非ダイヤモンド層小片とダイヤモンド層小片とを交番的に順次配置して成るチップを作り、これらのチップをブレード基板外周辺部に接着して成る石材等切断用ダイヤモンドブレードに於いて、チップを構成する、ダイヤモンド層小片としては、ダイヤモンド砥粒には60 USメッシュより細い粒径をえらび、ダイヤモンド含有量は、従来用いられているチップに較べて1.5倍以上になるようにダイヤモンド砥粒と砥粒結合用金属粉末とを混合した粉末を、冷間にて成型してダイヤモンド層小片となしたもの用い、非ダイヤモンド層小片としては、銅又は銅

合金或いはその他の金属粉末を70乃至95重量%と、グラファイト粉末、又は銅又はニッケルをコートしたグラファイト粉末30乃至5重量%との混合粉末を冷間で成型して非ダイヤモンド層小片となしたものを用い、これらのダイヤモンド層小片と非ダイヤモンド層小片とを交番的に順次配置し、この配置に当ってはダイヤモンド層小片がチップの前後端に配置されるようにして、所定の長さの小片集積体を作り、これを抵抗焼結その他の方法を用いて焼結してチップを完成し、かくして得たチップをブレード基板外周に接着することを特徴とする石材等切断用ダイヤモンドブレードの製造法。

3. 発明の詳細な説明

石材やコンクリート製品を、ダイヤモンドブレードを用いて切断する時発生する強烈な騒音は、公害問題の一つとしてとらえられているが、問題解決の為には、作業室を密閉するか、工場を移転する他には、有効な方法はまだ開発されていない。

従って切断作業の際に起る騒音を、皆無にすることはできないにしても、騒音軽減に寄与することができる方法の開発が要請されている。

本発明は使用中に騒音を発生することの少いブレードに関するものである。石材等切断用ダイヤモンドブレードにおいては、基板外周に装着されているチップが相手材に切込んでゆく時、チップ数と周速の相乗積に相当する周期的外力が、衝撃の形でチップから基板に伝達され、この外力に因る歪が基板内に強制的に誘発される。ブレードは一般に、外径の割には薄い板材を用いて作ってあるので、上記歪の寸法も大きく、しかも大口径ブレードを駆動する機械には大出力のモータが装着されているので上記の歪は更に大きくなる。この強制的歪はチップ数と周速との相乗積の濃度で基板内に起り、板材の固有振動に因る残響と重畠して、騒音の形となって耳に到達する。このような騒音は、チップ刃先が相手材料に切込んで行く時、刃先が受ける衝撃が主な原因で起るものであるから、チップ刃先の切味を良くして、チップ刃先が

相手材料に切込んでゆく時の切削抵抗を少くし或是、衝撃が減衰されて基板に伝達されるようにすることができれば、騒音を著く軽減することができるはずである。

従来のブレードに、装着してあるチップは、ダイヤモンド砥粒と、砥粒結合材との混合粉末を焼結して作った緻密な製品であって、衝撃にも摩擦にも強く、剛性の高いものであるから、チップ刃先で発生した衝撃は全部直接基板に伝達され、この衝撃に相当した騒音が発生している。

本発明ブレードに於いては、ダイヤモンド砥粒とその結合材との混合粉末を冷間で成形固結したダイヤモンド層小片複数個と、ダイヤモンドを含まない、銅、銅合金その他の金属粉とグラファイト粉末との混合物を冷間で成形固結した非ダイヤモンド層小片複数個とを交番的に配列して所定の長さにまとめたものを、焼結して成るチップを用いており、チップの構造は従来のものとは全く異なるものである。始めに実施例に示すような、ダイヤモンド層小片 3 個、非ダイヤモンド層 2 個とよ

り成るチップについて説明する。かかるチップ 1 個において、外形寸法および含有されるダイヤモンド砥粒の総重量が従来の形式のチップと同一とすれば、各小片の体積が等しい場合には、ダイヤモンド層小片 1 個には、全ダイヤモンド量の  $\frac{1}{3}$  が含まれ、その小片の体積はチップ 1 個の  $\frac{1}{3}$  であるから、ダイヤモンド小片内におけるダイヤモンド粒子の濃度は、従来形チップの同じ部分の  $\frac{5}{3}$  倍になる。そのうえ、従来のブレードのチップに於いては、ダイヤモンド砥粒として 30~40 US メッシュのものを用いているのに対し本発明ブレードのチップでは特許請求範囲に示したように、60 US メッシュより細い砥粒を用いているので、使用するダイヤモンド砥粒の重量は同じでも、砥粒数は著しく多くなり、更に砥粒が細いほど組織は緻密となり鋭利な刃先を形成するので、刃先の切味は著しく改善される。切味が良くなれば相手材料に切込む時の抵抗が少くなり、衝撃によって基板内に誘起される強制的振動即ち騒音のレベルも低下する。砥粒径 100~120 US メッシュの砥粒を用い

た実施例のブレードは 30~40 US メッシュの砥粒を用いた従来のブレードに比し実施例に示す良好な成績を示した。

本発明ブレード用チップは数個の区分に分かれていて、ダイヤモンド層小片の次に非ダイヤモンド層小片を配置し、以下順次両小片を交番的に配列して成るものであって、非ダイヤモンド層の方がダイヤモンド層より先に磨耗するので、ダイヤモンド層小片外周と非ダイヤモンド層小片外周との間に段差ができる。非ダイヤモンド層小片の次に在るダイヤモンド層小片の先端が切刃としての機能を發揮するようになる。従って、チップ 1 個が複数個の切刃を持つことになって、チップの切味は著しく増大する。実施例に示すチップの場合は、ダイヤモンド層小片が 3 個在るので、このチップに於いては合計 3 個の切刃を備えることになる。このように 1 個のチップが数個の切刃を具備することは、そのチップの切味が増すことになるので、本発明ブレード用チップが切味の増大によって、騒音の低下に著しく貢献していることは明

白である。

次に本発明ブレードのチップを構成する非ダイヤモンド層小片について説明する。この非ダイヤモンド層小片は、銅、銅金その他の金属粉末と、クラファイト粉末或は、銅又はニッケルをコーティングしたクラファイト粉末との混合粉末を冷間で成形固結して作ったものであって、組織内にはクラファイト粒子が分散配置された状態となり、恰かも球状黒鉛鉄の組織と類似した組織になっている。球状黒鉛鉄を用いて作った機械は、他の材料を用いて作った機械よりも静かに運転できるので、その意味からこの材料は注目をあびるようになつたが、この性質は鉄組織の中に黒鉛粒子が含まれていることによって発揮されているのである。この性質は、周期的に作用する外力に対して材料内部に起る内部摩擦により、外部から加えられる変形エネルギーの一部が熱エネルギーに変ることによって、外力の作用が緩和され、同時に音の吸収もこれに伴つて起ると云う原理に基くものと考えられ、この原理は球状黒鉛鉄と類似した組織

であるクラファイト粉末を含有する組織を有する本発明ブレードに装着するチップにおける非ダイヤモンド層小片にも適用可能であると考えられる。即ち本発明ブレードに装着するチップは既述のダイヤモンド層小片と上述の非ダイヤモンド層小片とを交番的に配列し、所定の長さにまとめたものを焼結して成るものであつて、チップの前後両端にはダイヤモンド層小片が位置するように作られているので、このチップが相手材料に切込んでゆく時の状態を考えると、チップ先端のダイヤモンド層小片が受ける周期的衝撃に因る変形エネルギーは基板本体と、ダイヤモンド層小片の次に配置されている非ダイヤモンド層小片とに伝達されるが、非ダイヤモンド層に伝達された変形エネルギーは前述の理由により非ダイヤモンド層自身の内部で緩和され、この緩和された力が基板に伝達されることになる。即ち本発明ブレードにおいては、チップが相手材料に切込んでゆく時、基板に伝達される周期的外力が緩和されるので、基板内に強制的に誘起される振動の量も緩和される。従つて

従来型ブレードに於いてチップに作用する周期的外力の全量が基板に伝達される場合に較べて静かに運転できることになる。

以上の説明で明らかにされたように、本発明ブレードは、60 US メッシュより細いダイヤモンド砥粒を多量に含有させて刃先の鋭利さを著しく高めたダイヤモンド層小片をチップの前後端に配置することに因つて切味を良くし、以つて相手材料に切込んでゆく時の衝撃を軽減することにより、基板内に誘起される強制的振動の量即ち騒音の量を低下させ、又、チップを構成するに当り、ダイヤモンド層小片と非ダイヤモンド層とを順次交番的に配列することにより、非ダイヤモンド層の方がダイヤモンド層より先に磨耗して両者の間に段差を生じ、非ダイヤモンド層の次に在るダイヤモンド層の先端が切刃の機能を発揮するようになつて、1個のチップに於ける切刃の数が増した状態になり、チップの切味が向上して騒音の低下に寄与し、更にチップを構成している非ダイヤモンド層にクラファイト粉末を含有させることによって、

チップに加えられる周期的外力が、この非ダイヤモンド層小片に先行する位置にあるダイヤモンド層小片を経由してこの非ダイヤモンド層小片に伝達された時、非ダイヤモンド層組織の内部摩擦により上記外力が緩和され、この緩和された外力が基板に伝達されることにより、基板に誘起される強制振動が低下、即ち騒音が低下することになる。

第1図は従来型ブレードに装着したチップの取付け状態を示す部分図であつて、1は基板、2は従来型チップ1個の外形を示し、3はこのチップにまばらに含まれる30 US メッシュ前後の大きさのダイヤモンド粒子、4はダイヤモンド粒子を固結する為に用いられている結合材部を示し、このチップは基板外周にロク付けされている。5, 5'は上記チップ2の隣のチップの一部、6, 6'は基板外周に設けた溝を示す。従来形のブレードに於いては、チップが含有しているダイヤモンド砥粒の大きさが上記のように大きいので、チップ1個当たりのダイヤモンド含有総重量が一定の場合には、砥粒径が大きい時は砥粒の分布がまばらであるか

ら、チップの刃先を鋭利にすることはできない。

第2図は本発明ブレードに装着したチップの構造と、取付状態を示す部分図である。チップ10は基板7の外周にロウ付けしてあり、従来形ブレード用チップと同一寸法に作られている。ダイヤモンド層小片8, 8'をチップ10の前後両端に配置し、これらに續いて非ダイヤモンド層小片9, 9'を、更にこれらの間にダイヤモンド層小片8'を配置するものとする。この図で示す場合にはチップ全体を5個の区分に分ち、うちダイヤモンド層小片は3個、非ダイヤモンド層小片は2個になっている。従って、チップ1個に含まれるダイヤモンド砥粒の総重量を従来のブレード用チップと同一とすれば、このダイヤモンド層小片1個に含まれるダイヤモンド砥粒の量は全量の1/3となるので、ダイヤモンド層小片1個に於けるダイヤモンド含有率は5/3となる。このことは、この部分におけるダイヤモンド濃度が従来形ブレード用チップの同じ部位におけるダイヤモンド濃度の5/3倍になることを意味する。更に本発明ブレード用チップ

特開昭57-33969(4)  
のダイヤモンド層小片には60 USメッシュより細い砥粒を用いるので、含有するダイヤモンド砥粒の重量が従来チップと同じでも、砥粒の個数は著しく多数である。従ってチップの先端には鋭利な刃先が形成され切味が著しく向上する。

第3図は本発明ブレード使用開始後の非ダイヤモンド層小片の方がダイヤモンド層小片よりも先に磨耗した状態を示す側面要領図である。図において12, 12'は非ダイヤモンド層小片部であって、この小片にはダイヤモンド砥粒を含んでいないので、多量のダイヤモンド砥粒を含有しているダイヤモンド層小片11, 11', 11''より先に磨耗し、両者の間には段差が生ずる。従って非ダイヤモンド層小片12に續くダイヤモンド層小片11'の先端13は第2の切刃としての機能を持つに至る。この事は1個のチップが複数の切刃を持つことを示し、従来形ブレードにおけるチップのように、1個のチップに1個の切刃しか持たない場合に較べて、切味が良く、衝撃が少く、従って騒音も低下する。

以下実施例によって説明する。

### 実施例 1

粒径200～230 USメッシュの銅粉92重量%と、粒径200～230 USメッシュのグラファイト粉末50重量%に銅を50重量%の割合で、メッキ法によつてコートした市販の銅コートグラファイトを、8重量%の割合を以つて混合した粉末を作り、これを冷間で成形して厚さ8mm、高さ8mm、長さ7mmの非ダイヤモンド層小片を作り、別に、100～120 USメッシュのダイヤモンド粉末0.74 ctsと結合材とを混合して厚さ8mm、高さ8mm、長さ7mmになるように冷間で成型して、ダイヤモンド層小片を作った。この場合この小片のダイヤモンド含有率は1.65 ct/ccであつて、上記のダイヤモンド重量0.74 ctsは従来のチップ1個に含まれるダイヤモンド重量2.24 ctsを3個のダイヤモンド層小片に均等に分割した値である。今ダイヤモンド層小片をA、非ダイヤモンド層小片をBとし、A, B, A, B, Aの順に配置して、長さを35mmの集積体を作った。この方法は従来のブレード用チップと同一方法であつて、そのうえダイヤモンド砥粒の

含有総重量も従来チップと同一である。即ち本実施例の場合には、ダイヤモンド層小片が3個、非ダイヤモンド層小片が2個より成るチップを作つたが、此場合ダイヤモンド砥粒の総量の1/3がダイヤモンド層小片1個に含まれており、この小片の体積はチップ1個の1/3であるから、この小片に於けるダイヤモンド砥粒含有濃度は5/3倍となる。かくして得た両小片の集積体を抵抗焼結法により焼結してチップの完成品を作った。このようにして作ったチップを、基板外周にロウ付けして、外径1,000mmの本発明ブレードを作り、このブレードと、従来のチップを用いて作ったブレードとを用いて、同一条件のもとで、石材切断性能の比較を行つた結果、本発明ブレードは下表に示す優秀な性能を發揮することが判つた。

区分	従来のブレード	本発明ブレード
騒音(ファン)	91	84

なお94ファンは通常の機械工場等の騒音と同程度であつて直ちの会話は支障なし程度の騒音である。

ブレード外周に起る、非ダイヤモンド層の磨耗状態を示す図である。

## 第1図

- 1 … ブレードの基板
- 2 … 従来形チップの 1/4 個分を示す
- 3 … 従来形チップに含まれる大形ダイヤモンド砥粒がまばらに存在している状況を示す
- 4 … ダイヤモンド砥粒を結合する結合材部を示す
- 5, 5' … 上記チップの隣のチップ
- 6, 6' … 基板外周に設けた溝

## 第2図

- 7 … 本発明ブレードの基板
- 8, 8', 8'' … ダイヤモンド層小片で、細いダイヤモンド砥粒多数個が高密度で含まれている様子を示す
- 9, 9' … 非ダイヤモンド層小片
- A … ダイヤモンド層小片の記号
- B … 非ダイヤモンド層小片記号
- 10 … 本発明ブレード用チップ 1 個分を示す

## 4. 図面の簡単な説明

第1図は従来形ブレードの平面図においてチップ取付関係を示す要領図、第2図は本発明ブレードの平面図において、チップ取付け関係を示す要領図、第3図は本発明ブレードを使用した場合に

## 第3図

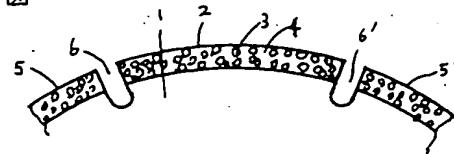
11, 11', 11'' … ダイヤモンド層小片  
 12, 12' … 非ダイヤモンド層小片の外周部が磨耗した状態を示す  
 13 … 第2の切刃

特許出願人

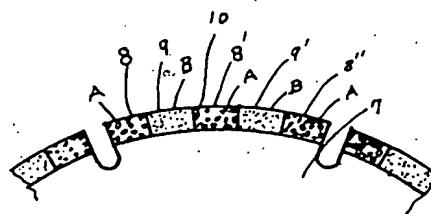
井 上 仁 郎



## 第1図



## 第2図



## 第3図



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(54) Title: MANUFACTURING METHOD OF DIAMOND  
BLADE FOR CUTTING BUILDING STONE AND  
THE LIKE

5-6-5-303 Kami-Tsuruma,  
Sagamihara-shi

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(71) Applicant:

Jiro Inoue  
5-6-5-303 Kami-Tsuruma,  
Sagamihara-shi

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(72) Inventor: Jiro Inoue

### 1. Title of the Invention

#### MANUFACTURING METHOD OF DIAMOND BLADE FOR CUTTING BUILDING STONE AND THE LIKE

### 2. Claims

A method for manufacturing a diamond blade for cutting building stone and the like, said method being characterized by the fact that in a diamond blade for cutting building stone and the like in which [a] respective tips are formed by an odd number of diamond layer pieces and an even number of non-diamond layer pieces as tips which are mounted on the circumferential portion of said diamond blade for cutting building stone and the like, [b] said tips are constructed with diamond layer pieces positioned at the leading and trailing ends of each tip, and with non-diamond layer pieces and diamond layer pieces installed in an alternating manner in the intermediate portion of each tip, and [c] the abovementioned tips are mounted on the circumferential portion of a blade base, [i] diamond layer pieces which use diamond abrasive grains with a particle diameter finer than 60 US mesh, and which are formed by the cold molding of a powder obtained by mixing said diamond abrasive grains with a metal powder used for abrasive grain bonding so that the diamond content is 1.5 times the diamond content of conventional tips (or more), are used as the abovementioned diamond layer pieces, [ii] non-diamond layer pieces which are formed by the cold molding of a mixed powder containing powdered copper, a powdered copper alloy or some other powdered metal at the

rate of 70 to 95 wt %, and powdered graphite or powdered graphite coated with copper or nickel at the rate of 30 to 5 wt %, are used as the abovementioned non-diamond layer pieces, [iii] aggregates of the abovementioned diamond layer pieces and non-diamond layer pieces which have a prescribed length are formed by successively positioning said pieces in an alternating manner so that diamond layer pieces are positioned at the leading and trailing ends of each tip, [iv] tips are completed by sintering these aggregates by means of resistance sintering or some other method, and [v] the tips thus obtained are mounted on the outer circumference of a blade base.

### 3. Detailed Description of the Invention

The loud noise that is generated when building stone and concrete products are cut using diamond blades is treated as a pollution problem; however, no method of solving this problem has been developed, other than the tight sealing of work rooms or the transfer of plants to remote locations. Accordingly, there is a need for a method which can

[Translator's note: the term shown as "chip 10" in the English abstract would seem more likely to be "tip 10" based on the context. "Chip" and "tip" are phonetically identical in Japanese.]

contribute to the lessening of the noise generated in such cutting work, even though it may be impossible to eliminate such noise completely.

The present invention concerns a blade which generates little noise during use. In the case of diamond blades used for the cutting of building stone, etc., the following problem arises: i. e., when the tips mounted on the outer circumference of the blade base cut into the material being worked, a periodic external force corresponding to the geometrical product of the number of tips and the peripheral speed is transmitted from the tips to the blade base in the form of an impact, so that distortion caused by this external force is forcibly induced in the interior of the blade base. Generally, such blades are constructed from a plate material which has a small thickness relative to the diameter of the blade. Accordingly, the dimensions of the abovementioned distortion are large; furthermore, in the case of machines which drive large-diameter blades, a large-output motor is mounted in the machine so that the abovementioned strain is increased even further. This forcible distortion occurs in the interior of the blade base at a frequency determined by the geometrical product of the number of tips and peripheral speed, and is superimposed on the reverberation caused by the characteristic vibration of the plate material, so that said distortion reaches the ear in the form of noise. Since such noise occurs mainly as a result of the shock received by the tip cutting edges when said cutting edges cut into the material being worked, it should be possible to achieve a conspicuous reduction in said noise by improving the sharpness of the tip cutting edges so that the cutting resistance that occurs when the tip cutting edges cut into the material being worked is reduced, or by constructing the blade so that the aforementioned shock is transmitted to the blade base in an attenuated form.

The tips mounted on conventional blades are dense, finely grained tips formed by sintering a mixed powder consisting of diamond abrasive grains and an abrasive grain bonding material. Such tips are resistant to both shock and friction, and have a high rigidity; accordingly, shocks generated in the tip cutting edges are transmitted directly to the blade base in their entirety, so that a noise corresponding to said shocks is generated.

The blade of the present invention uses tips which are produced by sintering an aggregate of a prescribed length formed by lining up [a] a plurality of diamond layer pieces formed by the cold molding of a mixed powder consisting of diamond abrasive grains and an abrasive grain bonding material, and [b] a plurality of non-diamond layer pieces formed by the cold molding of a mixture consisting of powdered copper, a powdered copper alloy or some other powdered metal and powdered graphite (containing no diamonds), in an alternating

arrangement. Thus, this tip structure is completely different from that used in a conventional blade. First, a tip consisting of three diamond layer pieces and two non-diamond layer pieces (such as that described in the working examples) will be described. In such a tip, assuming that the external dimensions and total diamond abrasive grain content are the same as in a conventional tip, then the concentration of diamond abrasive grains in each diamond layer piece will be  $5/3$  that in a similar portion of a conventional blade (since each diamond layer piece contains  $1/3$  of the total diamond content and the volume of each layer piece is  $1/5$  of the total volume of the tip if the respective layer pieces all have equal volumes). In addition, the diamond abrasive grains used in conventional blade tips have a size of 30 to 40 US mesh, while the diamond abrasive grains used in the tips of the blade of the present invention have a size of 60 US mesh or finer (as indicated in the claims section). Accordingly, even if the weight of diamond abrasive grains used is the same, the number of diamond abrasive grains used is conspicuously larger in the present invention. Since finer abrasive grains result in a finer texture, which makes it possible to form sharper cutting edges, the sharpness of the cutting edges is conspicuously improved. If the sharpness is thus improved, the resistance that occurs when the cutting edges cut into the material being worked is reduced, so that forcible vibration induced in the blade base by the cutting shock is also reduced (i. e., the noise level is reduced). Compared to conventional blades using abrasive grains with a size of 30 to 40 US mesh, the blades in the working examples (using abrasive grains with a size of 100 to 120 US mesh) showed favorable results (as is indicated in the working examples).

The tips used in the blade of the present invention are divided into a plurality of sections, with diamond layer pieces and non-diamond layer pieces arranged in an alternating manner. Since the non-diamond layer pieces wear more quickly than the diamond layer pieces, steps are formed between the outer circumferential edges of the diamond layer pieces and the outer circumferential edges of the non-diamond layer pieces, so that the edges of the diamond layer pieces located adjacent to the non-diamond layer pieces begin to act as cutting edges. Accordingly, each tip acquires a plurality of cutting edges so that the cutting ability of said tip is greatly increased. The tips described in the working examples have three diamond layer pieces; accordingly, these tips each have a total of three cutting edges. Since the fact that each tip has a plurality of cutting edges means that the cutting ability of the tips is increased, it is clear that the tips used in the blade of the present invention make a conspicuous contribution to noise reduction as a result of this

increase in cutting ability.

Next, the non-diamond layer pieces of the tips used in the blade of the present invention will be described. These non-diamond layer pieces are formed by the cold molding of a mixed powder consisting of powdered copper, a powdered copper alloy or some other powdered metal, and powdered graphite or powdered graphite coated with copper or nickel. Graphite particles are dispersed in the structure of these non-diamond layer pieces so that said pieces have a structure resembling that of cast iron containing spherical graphite. Machines manufactured using cast iron containing spherical graphite can be operated more quietly than machines manufactured using other materials; this feature is what first drew attention to this material. This noise-reducing effect results from the fact that graphite particles are contained in the cast iron structure. It is thought that this property is based on the following mechanism: i. e., in the case of external forces acting in a periodic manner, a portion of the deformation energy applied from the outside is converted into thermal energy by internal friction occurring inside the material, so that the effect of the external force is attenuated, and so that noise absorption also occurs. It appears that this principle can also be applied to the non-diamond layer pieces in the tips mounted on the blade of the present invention, which have a structure containing powdered graphite (similar to the structure of cast iron containing spherical graphite). Specifically, the tips mounted on the blade of the present invention are formed by sintering an aggregate (with a prescribed length) in which the abovementioned diamond layer pieces and non-diamond layer pieces are arranged in an alternating manner. These tips are constructed so that diamond layer pieces are positioned at the leading and trailing ends of each tip. Accordingly, considering the conditions that occur when these tips cut into the material being worked, the deformation energy caused by the periodic shock received by the diamond layer pieces of each tip is transmitted to the main body of the blade base and the non-diamond layer pieces located adjacent to said diamond layer pieces; however, the deformation energy transmitted to the non-diamond layer pieces is attenuated inside said non-diamond layer pieces for the reasons described above, and this attenuated energy is transmitted to the blade base. In other words, in the blade of the present invention, the periodic external force that is transmitted to the blade base when the tips cut into the material being worked is attenuated, so that the amount of vibration that is forcibly induced in the blade base is also reduced. Accordingly, the blade can be operated more quietly than is possible in the case of conventional blades, in which all of the periodic external force acting on the tips is transmitted to the blade base.

As is clear from the above description, the blade of the present invention shows an improved cutting ability as a result of the fact that diamond layer pieces which contain large quantities of diamond abrasive grains finer than 60 US mesh (so that the cutting edges of said diamond layer pieces are conspicuously sharpened) are positioned at the leading and trailing ends of each tip of said blade. In the blade of the present invention, therefore, the shock that occurs when the tips cut into the material being worked is alleviated, so that the amount of forcible vibration induced in the blade base, i. e., the amount of noise generated, is also reduced. Furthermore, as a result of the fact that diamond layer pieces and non-diamond layer pieces are positioned in an alternating manner in the construction of the tips, steps are generated between the diamond layer pieces and the non-diamond layer pieces (due to the fact that the non-diamond layer pieces wear more quickly than the diamond layer pieces), so that the edges of the diamond layer pieces located adjacent to the non-diamond layer pieces acquire the function of cutting edges, thus resulting in a state in which the number of cutting edges per tip is increased. As a result, the cutting ability of the tips is improved, and this improvement in cutting ability contributes to a reduction in noise. In addition, since the non-diamond layer pieces forming the tips contain powdered graphite, the aforementioned periodic external force applied to the tips is attenuated by internal friction occurring inside the non-diamond layer structure when said external force is transmitted to the non-diamond layer pieces via the diamond layer pieces located in positions preceding said non-diamond layer pieces, and this attenuated external force is transmitted to the blade base. As a result, the forcible vibration induced in the blade base is decreased, so that the noise level drops.

Figure 1 is a partial view which illustrates the conditions of attachment of the tips mounted on a conventional blade. In Figure 1, 1 indicates the blade base, 2 indicates the external shape of a conventional tip, 3 indicates large diamond particles (around 30 US mesh) which are sparsely distributed in the aforementioned tip, and 4 indicates a binder which is used to bond the aforementioned diamond particles. The abovementioned tip [2] is attached to the outer circumference of the blade base by brazing. 5 and 5' indicate portions of the two tips which are adjacent to the abovementioned tip [2]. 6 and 6' indicate grooves which are formed in the outer circumference of the blade base. In this conventional blade, the size of the diamond abrasive grains contained in the tips is large (as was described above); accordingly, assuming that the overall weight of the diamond particles contained in one tip is fixed, the

distribution of the abrasive grains becomes sparser as the size of the abrasive grains increases, so that the cutting ability of the tips cannot be improved.

Figure 2 is a partial view which illustrates the structure and conditions of attachment of the tips mounted on the blade of the present invention. Here, each tip 10 is attached to the outer circumference of the blade base 7 by brazing. These tips have the same dimensions as tips used in a conventional blade. Diamond layer pieces 8 and 8" are positioned at the leading and trailing ends of each tip 10; non-diamond layer pieces 9 and 9' are positioned adjacent to said diamond layer pieces 8 and 8", and a diamond layer piece 8' is positioned between said non-diamond layer pieces 9 and 9'. In the case illustrated in this figure, each tip is divided into five sections, i. e., three diamond layer pieces and two non-diamond layer pieces. Accordingly, assuming that the total diamond abrasive grain content is the same as in a conventional tip, then the diamond content of each diamond layer piece is 5/3 [sic] (since each diamond layer piece contains 1/3 of the total diamond abrasive grain content). This means that the diamond concentration in each diamond layer piece is 5/3 the diamond concentration in a similar portion of a tip used in a conventional blade. Furthermore, since diamond abrasive grains finer than 60 US mesh are used in the diamond layer pieces of the tips of the blade of the present invention, the number of diamond abrasive grains contained in each tip is conspicuously greater than the number of diamond abrasive grains in a conventional tip, even if the weight of said diamond abrasive grains is the same. Accordingly, sharp cutting edges are formed on the edges of each tip, so that the cutting ability is conspicuously improved.

Figure 3 is a partial side view which shows how the non-diamond layer pieces wear more quickly than the diamond layer pieces after use of the blade of the present invention is begun. In Figure 3, 12 and 12' indicate non-diamond layer pieces; since these non-diamond layer pieces contain no diamond abrasive grains, said non-diamond layer pieces wear more quickly than the diamond layer pieces 11, 11' and 11" which contain numerous diamond abrasive grains, so that steps are generated between said non-diamond layer pieces and diamond layer pieces. Accordingly, the leading edge 13 of the diamond layer piece 11' which follows the non-diamond layer piece 12 eventually acquires the function of a second cutting edge. This means that a single tip acquires a plurality of cutting edges, so that the cutting ability is improved compared to cases where a single tip has only a single cutting edge (as in tips used in conventional blades). Accordingly, the shock is reduced so that the noise level is lowered.

Below, the present invention will be described in terms of working examples.

### Working Example 1

A powder was prepared by mixing 92 wt % powdered copper (particle size: 200 to 230 US mesh) and 8 wt % commercially marketed copper-coated graphite coated by the plating method using 50 wt % copper on 50 wt % powdered graphite (particle size: 200 to 230 US mesh). This powder was cold-molded to form non-diamond layer pieces with a thickness of 8 mm, a height of 8 mm and a length of 7 mm. Separately, a binder was mixed with 0.74 cts of powdered diamond (particle size: 100 to 120 US mesh), and this mixture was cold-molded to produce diamond layer pieces with a thickness of 8 mm, a height of 8 mm and a length of 7 mm. In this case, the diamond content of the abovementioned diamond layer pieces was 1.65 ct/cc; the abovementioned diamond weight of 0.74 cts was arrived at by dividing the diamond weight of 2.24 cts contained in a conventional tip equally among three diamond layer pieces. Here, where A indicates diamond layer pieces and B indicates non-diamond layer pieces, the respective layer pieces were arranged in the order A, B, A, B, A, thus producing an aggregate with a length of 35 mm. This method was the same as that used for a conventional blade tip, and the overall diamond abrasive grain content was the same as that in a conventional tip. In other words, in the present working example, a tip consisting of three diamond layer pieces and two non-diamond layer pieces was prepared; in this case, since each diamond layer piece contained 1/3 of the overall amount of diamond abrasive grains used, and since the volume of each diamond layer piece was 1/5 of the volume of the tip, the concentration of diamond abrasive grains in each diamond layer piece was 5/3 [that in a similar portion of a conventional tip]. The aggregate of layer pieces thus obtained was sintered by a resistance sintering method, thus producing a finished tip. Tips produced in this way were attached to the outer circumference of a blade base by brazing, thus producing a blade of the present invention (diameter: 1,000 mm). A comparative test of building stone cutting performance was performed (under the same conditions) using this blade and a blade prepared using conventional tips. As a result, the blade of the present invention showed the superior performance indicated in the table below.

Test Sample	Conventional Blade	Blade of the Present Invention
Noise (phons).	91	84

[Handwritten entry:]

Furthermore, 84 phons is approximately equal to the noise level of ordinary machinery/plant interiors, and is a noise level that does not interfere with ordinary conversation.

## Working Example 2

Non-diamond layer pieces were prepared as in Working Example 1 using a mixed powder formed by mixing 90 wt % powdered bronze (particle size: 200 to 230 US mesh) and 10 wt % commercially marketed nickel-coated graphite produced by flame coating using 55 wt % nickel on 45 wt % powdered graphite (particle size: 200 to 230 US mesh). Furthermore, diamond layer pieces were prepared in the same manner as in Working Example 1. These working layer pieces are combined into 35-mm aggregates as in Working Example 1, and were sintered to produce completed tips. Using these tips, a blade was manufactured as in Working Example 1, and a comparative test of building stone cutting performance was performed using this blade and a conventional blade. As a result, the blade of the present working example showed more or less the same superior results as the blade obtained in Working Example 1.

## 4. Brief Explanation of the Figures

Figure 1 is a partial view which shows the tip attachment relationship in a plan view of a conventional blade. Figure 2 is a partial view which shows the tip attachment relationship in a plan view of a blade constructed according to the present invention. Figure 3 is a diagram which illustrates the wear of the non-diamond layer that occurs at the outer circumference of the blade (in a case where the blade of the present invention is used).

Figure 1

1 indicates the blade base. 2 indicates a conventional tip. 3 indicates the sparse distribution of large diamond abrasive grains in said conventional tip. 4 indicates a binder which bonds the diamond abrasive grains. 5 and 5' indicate tips adjacent to the abovementioned tip. 6 and 6' indicate grooves formed in the outer circumference of the blade base.

Figure 2

7 indicates the blade base of the present invention. 8, 8' and 8" indicate diamond layer pieces which contain numerous fine diamond abrasive grains at a high density. 9 and 9' indicate non-diamond layer pieces. A is a symbol which indicates diamond layer pieces. B is a symbol which indicates non-diamond layer pieces. 10 indicates one tip used in the blade of the present invention.

Figure 3

11, 11' and 11" indicate diamond layer pieces. 12 and 12' indicate the wear of the outer circumferential portions of the non-diamond layer pieces. 13 indicates a second cutting edge.

Applicant: Jiro Inoue [seal]

Figure 1

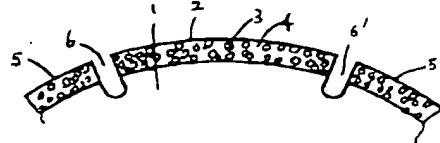


Figure 2

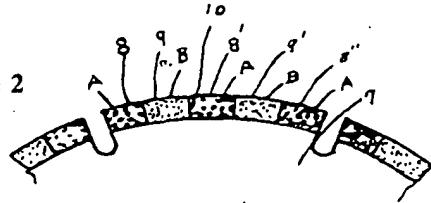


Figure 3

